LTE Roaming

Agenda

- LTE Overview and Evolution
- Overview of NIST and what they are doing
- Waiver Participants
- Roaming for Public Safety
  - Network topology
  - Public safety NNI's
- Conclusion

Why LTE?

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- Enhanced User Experience
- Simplified Network Architecture (Flat IP-based)
- Efficient Interworking
- Lower Capex and Opex
- High level of Security
- Robust QoS framework
- Common evolution for multiple technologies

GSM Standards Evolution

- The first GSM System was launched in 1992
  - TDMA Technology – circuit switched voice and data
  - Broad based European industry participation
- GPRS (General Packet Radio Service) launched in 1999
  - TDMA packet data service, 20-60 kb/s typical user rates
- EDGE (Enhanced Data Rates for GSM Evolution) launched in 2001
  - Enhanced TDMA packet data, 50-150 kb/s typical data rates
- UMTS (Universal Mobile Telecommunication System) launched in 2001
  - 3G CDMA technology in 5 MHz channels, also referred to as WCDMA
  - Circuit switched and packet services; 200-300 kb/s typical data rates
- UMTS - HSPA (High Speed Packet Access)
  - HSPDA (High Speed Downlink Packet Access) launched in 2005
    - Higher speed packet services, 400-700 kb/s typical downlink user rates
  - HSUPA (High Speed Uplink Packet Access) launched in 2007
    - Higher speed packet data uplink, ~500 kb/s typical user rate
  - HSPA+ (Evolved High Speed Packet Access) defined in 3GPP release 7
    - Provides HSPA data rates up to 56 Mb/s on the downlink and 22 Mb/s on the uplink

Evolution Paths to LTE

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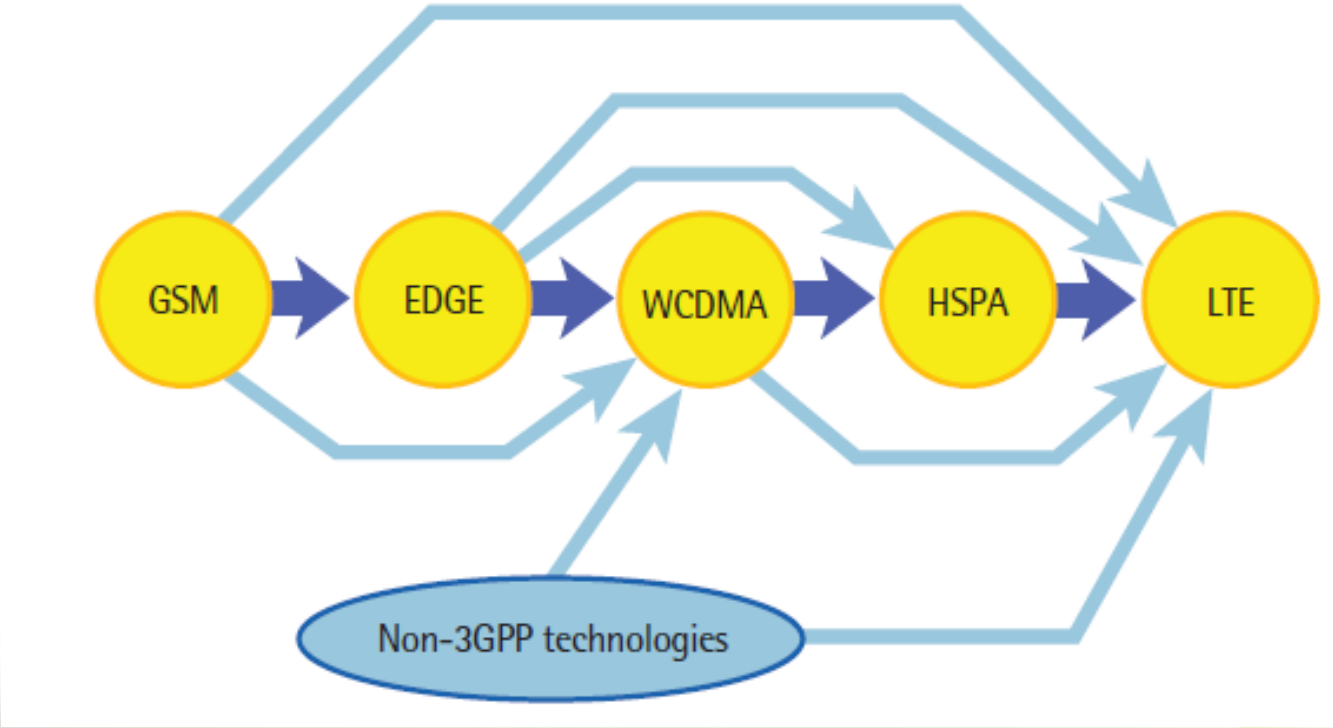
- Mobile operators are evolving towards LTE/SAE using different evolution paths
  - 3GPP family: GSM, GPRS, EDGE, WCDMA, HSPA
  - Non-3GPP family: 1xRTT, EV-DO, WLAN, WiMAX



Emerging Evolution Paths

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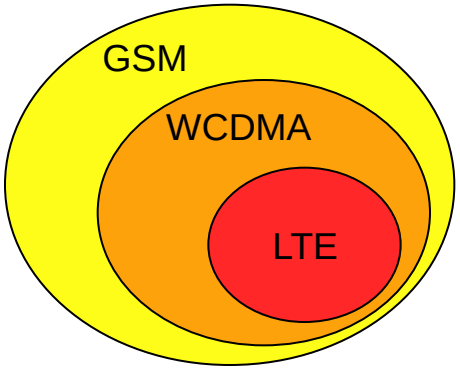
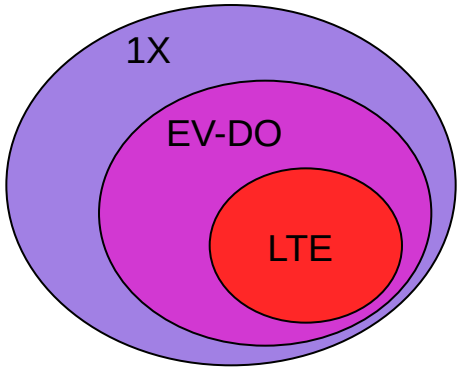
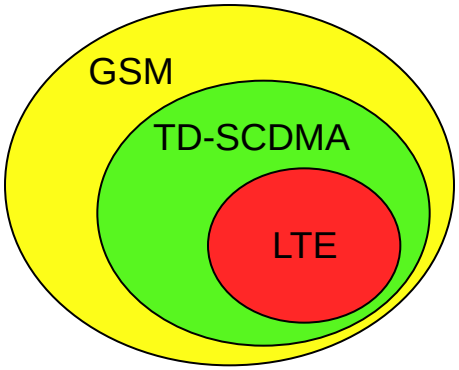


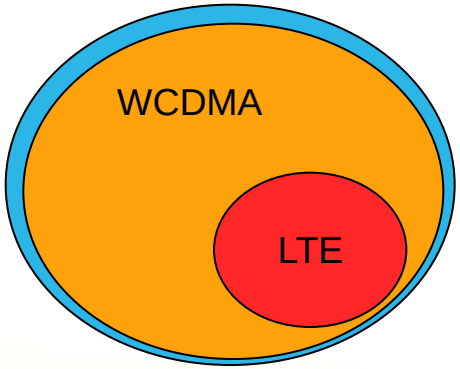
1. Most of the World



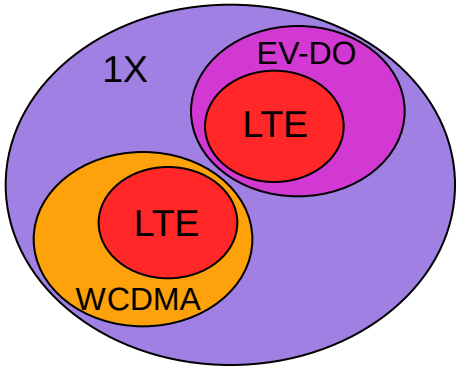
2. 3GPP2 Operator



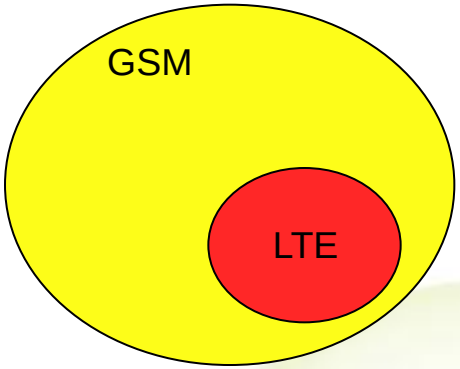
3. China Mobile



4. Japan



5. U.S.A. and Korea



6. Fast adopter

What Are Some North American Operators Doing About LTE?

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- Several different strategies being pursued by North American Operators:
  - LTE deployed in Las Vegas, new markets coming on-line.
  - LTE Only – Carriers have announced deployment plans of LTE data only networks. Details include:
    - Commercial deployments beginning in 2010
    - Initial deployment will be in new 700 MHz spectrum
    - Dual IMSI support
    - Initial devices will be mutli-mode data cards supporting:
      - 2G/3G GSM data
      - EV-DO CDMA data
      - 1xRTT CDMA data
      - LTE data
      - SMS (LTE SMS support not yet announced)

Challenges in LTE

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- Very complex technology
- Very expensive – significant R&D
- Interoperability
- Voice & SMS services
- Collaboration between multiple, diverse ecosystems

LTE Impact on Roaming

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- 3GPP Evolved Packet Core (EPC) and IMS specifications currently provide technical support for LTE roaming
- VoIP support in LTE impacts existing wholesale and retail charging models
- Existing GSMA documents and business procedures are currently addressing LTE roaming
  - New Network & Functional Elements (MME, SGW, PGW, PCRF, …)
  - New Interfaces (S6a, S8, S9, S13, …)
  - New Protocols (PMIP, STPc-v2, Diameter, SIP, …)

LTE Roaming Only – TAP Flow

- Call flow is PS Entity Roaming in another PS LTE Market
- CDR is generated by serving gateway
- CDR is sent to TAP creation
- CDR is turned into TAP record, rated and placed in TAP file
- TAP file is sent to Data Clearing House (DCH)
- DCH forwards the TAP file to Home network billing system

LTE Impact on Wholesale Charging

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- The GSMA Transferred Account Data Interchange Group (TADIG) is reviewing impact on wholesale clearing and settlement processes and TAP record specification
- Currently planning to add new Recording Entity Type Codes for the Serving and PDN Gateway network elements to TAP record specification in May 2010
  - Addition of QCI codes to TAP records under investigation
- Full TAP support for LTE/IMS roaming currently being developed by GSMA working groups

Overview of NIST Trial Network

- FCC has granted approval of 21 initial petitions for Public Safety
- Include cities and some states
- Conditions:
  - Mandatory use of 3GPP LTE
  - Must be interoperable between networks
  - Participate in network demonstrations with NIST
  - Offer service to all public safety and government organizations who request service
  - Will be in the 700MHz band
- Definition of Waiver
  - Spectrum originally allocated for future use
  - Waiver gives right to build network now

Waivers Granted

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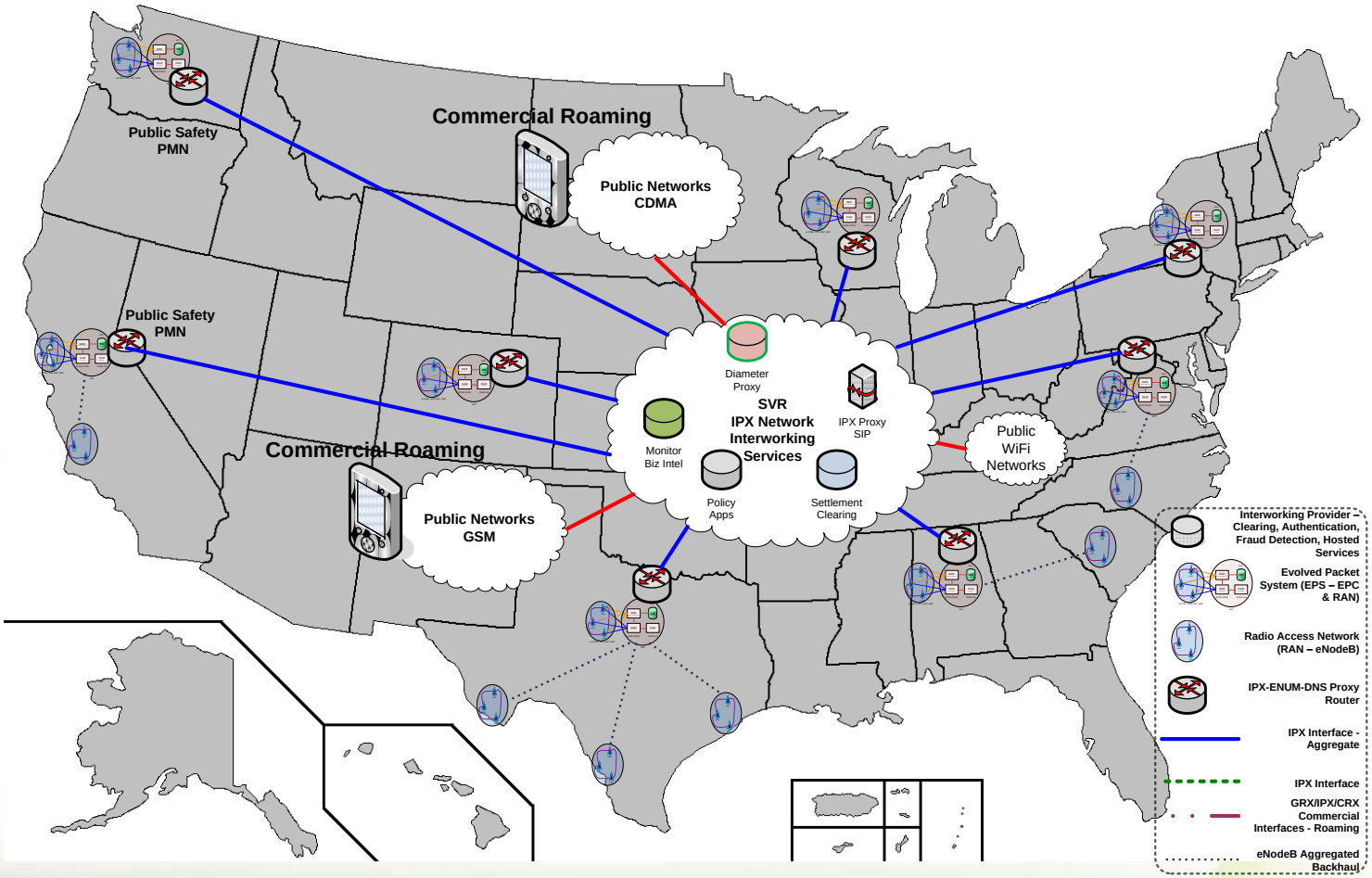
- Adams County, CO
- Alabama
- Boston, MA
- Northern California Consortium (Oakland, San Francisco, and San Jose)
- Charlotte, NC
- Chesapeake, VA
- District of Columbia
- Hawaii and Counties of Maui, Hawaii, Kauai, and City and County of Honolulu
- Iowa
- Los Angeles County
- Mesa, AZ and TOPAZ Regional Wireless Cooperative
- Mississippi
- New Jersey
- New Mexico
- New York City
- New York State
- Oregon
- Pembroke Pines, FL
- San Antonio, TX
- Seattle, WA
- Wisconsin Consortium (Calumet, Outagamie and Winnebago Counties)

Public Safety Hub Design



Network Topology Interfaces and Assumptions

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- Trial needs to simulate roaming between individual public safety networks
- Each state will have a separate Mobile Country Code and Mobile Network Code (MCC + MNC)
- Two networks will be intra with third network inter for roaming
- Each participant will have a Home Subscriber Subsystem (HSS) Mobility Management Entity (MME) and Policy Charging and Rules Function (PCRF)
- Each entity will need access to all other entities
- Diameter Proxy will be required to route traffic to correct HSS

Network Elements Needed for Trial

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- S6a Interface MME to HSS
- S8 Interface Serving Gateway (Visited) to PDN Gateway (Home)
- S9 V-PCRF to H-PCRF
- S10 MME to MME (Potentially)
- Class and Quality of Service (QoS and QCI) need to be supported
- No definition yet for voice support although we envisage IPX proxy

Conclusion

We make mobile work.

- Hubbing services provide interoperability to disparate wireless networks.
- Public Safety Networks should consider TAP; following the GSM model.
- Clearing and settlement services are done efficiently and effectively through clearinghouses.
- Syniverse does this everyday.

THANK YOU!